Burden of vision loss associated with eye disease in China 1990-2020: Findings from the Global Burden of Disease Study 2015

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SYNOPSIS

Alone among countries in the Group of G20, the age-standardized burden of vision loss from eye disease in China has risen over the last 25 years.

Abstract

Aims To assess the burden of vision loss due to eye disease in China between 1990 and 2015, and to predict the burden in 2020.

Methods Data from the Global Burden of Diseases, Injuries, and Risk Factors Study 2015 (GBD 2015) were used. The main outcome measures were prevalence and Years lived with disability (YLDs) for vision loss due to Cataract, Glaucoma, Macular degeneration, Other vision loss, Refraction and accommodation disorders and Trachoma.

Results Prevalence for eye diseases increased steadily from 1990 to 2015, and will increase till 2020. From 1990 to 2015, the most common eye disorder was Refraction and accommodation disorders. From 1990 to 2015, the vision loss burden due to eye disease decreased for those aged 0-14 years, and increased for those aged 15 years and above, with the most notable increases occurring among those aged 50 years and above. China ranked 10th when comparing YLDs for vision loss due to eye disease with the other members of the G20. Age-standardized YLD rates for vision loss due to eye disease declined in all 19 countries, except for China. The burden from vision loss due to eye disease ranked 12th and 11th among all causes of health loss in China in 1990 and 2015 respectively.

Conclusion Alone among major economies, China has experienced an increase in the burden of age-standardized vision loss from eye disease over the last two decades. In the future, China may expect a growing burden of vision loss due to population growth and ageing.

Keywords: Vision; Epidemiology; Public health; Years lived with disability

China has the world's largest population, over 1.406 billion, accounting for nearly 20% of the earth's inhabitants.[1] China has made enormous strides in improving health in the past few decades: life expectancy at birth has steadily increased and the under-5 mortality rate has fallen sharply.[2-4] At the same time, more needs to be done to further enhance the quality of the longer lives of China's citizens. A comprehensive assessment of current and expected disease burdens can help to inform China's health reform efforts, and provide evidence to support long-range strategies.

Vision loss due to eye disease is a major health problem, greatly affecting quality of life. Globally as of 2015, 34.3 million people were blind, an additional 24.3 million had severe vision impairment, 214 million had moderate vision impairment, and 663 million had near vision impairment.[5] Vision loss is the third largest cause of impairment after anemia and hearing loss,[6] but the burden of vision loss in China remains unclear. The Global Burden of Diseases Study is the result of a worldwide collaboration aimed at quantifying various health metrics of loss to diseases and injuries. These metrics enable comparison of health data across boundaries of geography and time in a way that is more comprehensive and internally consistent than possible with previous data sources.[6-8]

Our study aims to quantify the burden of vision loss due to various eye diseases in China from 1990 to 2015 using the Global Burden of Diseases, Injuries, and Risk Factors Study 2015 (GBD 2015), and also to predict the burden in 2020.

METHODS

Data from the Global Burden of Diseases, Injuries, and Risk Factors Study 2015 (GBD 2015) from 1990 to 2015 were used to analyze the burden of vision loss due to eye disease in China.[7] We searched and extracted related data from the website database (http://ghdx.healthdata.org), which was set up and shared by the Global Burden of Disease Study group. Details on the data, approaches to enhancing data quality and comparability, and statistical modeling and metrics for the GBD 2015 have been reported previously.[6-9] In brief, the GBD study team collected data from household surveys archived in the Global Health Data Exchange, sources suggested by in-country experts, and surveys identified in major multinational survey data catalogues and Ministry of Health and Central Statistical Office websites. There were 38 studies included, and the full list of the studies has been uploaded as a Supplementary file (supplementary 1). Unpublished data and data from studies of Rapid Assessments of Avoidable Blindness (RAAB) were also included. GBD 2015 estimated incidence and prevalence of various conditions by age, sex, cause, year, and geography using a wide range of standardized analytical procedures, including data screening, data adjustment, DisMod-MR 2.1 estimation, and injury modeling strategies. The GBD investigators used numerous metrics to report results on health loss related to specific causes of disease and injury: deaths and death rates, years of life lost due to premature mortality (YLLs), years lived with disability (YLDs), and disability-adjusted life-years (DALYs).[2,9]

The main outcome measures of our study were prevalence and YLDs associated with the vision loss burden due to various eye diseases. YLDs refer to years of life lived with any short-term or long-term health loss, which were equal to the prevalence of the eye disease multiplied by its associated disability weight.[10] GBD 2013 included new data for disability weights, which quantify the severity of health loss associated with a particular disease.[8] Disability weights use numbers on a scale from 0 to 1 that represent the severity of health loss associated with a particular health state.[8,10-12] The severity of health loss was based on surveys of the general public in five countries (Bangladesh, Indonesia, Peru, Tanzania, and the USA) and an open internet survey.[8,10-12] YLD rates were calculated by dividing the number of years of life lost by the relevant population.[10-12] Age-adjusted rates were calculated using the WHO 2000-2025 World standard population, which excluded the effects of total population size and age structure.[8,9,12] The percentages for YLDs were calculated as the number of years lived with disability due to a specific disease divided by the total number of years lived with disability for all diseases.

The following six ocular diseases were listed in the GBD 2015: Cataract, Glaucoma, Macular degeneration (including age-related macular degeneration, myopic maculopathy and other macular disorders), Trachoma, Refraction and accommodation disorders and Other vision loss.[7] The other vision loss category included a total of 57 eye conditions.[13] The changing trends of the burden of vision loss over time and with age were investigated. We also compared the burden of vision loss in China with the burden of other diseases and with the burden of vision loss in other countries.

RESULTS

From 1990 to 2015, the most common eye disorder in China was Refraction and accommodation disorders (figure 1; supplementary 2), while the second most common was Cataract. It was followed by Other vision loss, then by Macular degeneration and Glaucoma, with Glaucoma being more common before 2005 and Macular degeneration more common after 2005. The prevalence for Trachoma was the lowest. All-age prevalences for all included eye diseases increased steadily from 1990 to 2015, and are projected to rise until 2020. Age-standardized prevalence rates for Refraction and accommodation disorders, Cataract and Other vision loss remained essentially unchanged, while age-standardized rates for Macular degeneration and Glaucoma increased slightly and those for Trachoma fell considerably.

From 1990 to 2015, the vision loss burden due to eye disease decreased for those aged 0-14 years, and increased for those aged 15 years and above, with the most notable increases occurring among those aged 50 years and above (figure 2; supplementary 3). The burden of vision loss due to every individual eye disease increased from 1990 to 2015 among those 50 and above, with the prevalence ranking of diseases remaining unchanged for most conditions: Refraction and accommodation disorders (1st), Cataract (2nd), Other vision loss (3rd) and Trachoma (6th). In 1990, the prevalence of Glaucoma ranked 4th and Macular degeneration ranked 5th among those 50 and above, while in 2015, the prevalence of Macular degeneration ranked 4th and Glaucoma ranked 5th among this age group. Refraction and accommodation disorders accounted for the majority of the burden of vision loss in all age groups both in 1990 and in 2015.

Table 1: All-age YLDs and age-standardized YLD rates for vision loss due to various eye diseases in 1990 and 2015 for 19 member countries of the Group of 20 (The 20th member is the European Union)

Country name	All-age YLD Total in 1990 (thousands)	All-age YLDs in 2015		Age-standardized YLD Rate in 1990 (per 100 000)	Age-standardized YLD in 2015	
		Total (thousands)	Rank		Rate (per 100 000)	Rank
Argentina	60.6	83.4	16	200.2	184.3	13
Australia	25.2	40.7	19	144.1	137.9	15
Brazil	304.3	571.4	5	304.6	295.4	8
Canada	32.3	50.6	18	112.5	111.4	19
China	**2047.6**	**3800.4**	**2**	**241.4**	**257.8**	**10**
France	96.8	127.4	14	143.2	134.4	16
Germany	162.7	198.2	10	164.1	152.9	14
India	2977.2	5358.2	1	574.4	539.0	1
Indonesia	451.6	700.6	3	416.1	368.1	5
Italy	143.7	192.6	11	207.3	193.9	12
Japan	364.3	566.9	6	268.8	261.3	9
Mexico	218.7	424.2	8	405.3	405.1	3
Russia	507.6	615.4	4	327.9	317.0	6
Saudi Arabia	38.5	78.7	17	420.4	371.0	4
South Africa	106.2	176.1	12	430.5	420.7	2
South Korea	90.6	150.4	13	267.9	254.0	11
Turkey	138.0	223.1	9	348.7	314.8	7
United Kingdom	99.1	114.9	15	142.2	132.7	17
United States	313.9	444.2	7	116.5	115.0	18

YLDs: years lived with disability

We compared YLDs for vision loss due to eye diseases in China with that of the other 18 member countries of the G20 (the 20th member is the European Union) (table 1). We found that all-age YLDs for the burden of vision loss increased in all 19 countries between 1990 and 2015. In 2015, China ranked 2nd for all-age YLDs, behind only India. In terms of the age-standardized YLD rates for vision loss burden, China ranked 10th. Age-standardized YLD rates for vision loss due to eye diseases declined between 1990 and 2015 in all 19 countries except China.

Table 2: Top 20 causes of all-age YLDs and Age-standardized YLD rates in China in 1990 and 2015

Cause	All Age YLD in 1990		All Age YLD in 2015		Percentage change in All age YLD between 1990 and 2015 (%)	Age-standardized YLD Rate in 1990	Age-standardized YLD Rate in 2015	Percentage change in Age-standardized YLD Rate between 1990 and 2015 (%)
	Total (thousands)	Rank	Total (thousands)	Rank				
Lower back pain	6824.4	1	10445.6	1	53.1	696.0	655.8	-5.8
Neck pain	4948.6	3	9297.5	2	87.9	514.9	556.1	8.0
Age-related and other hearing loss	4784.0	4	8555.7	3	78.8	595.9	581.4	-2.4
Major depressive disorder	4565.1	5	6681.2	4	46.4	425.4	426.8	0.3
Diabetes mellitus	2793.7	10	5884.2	5	110.6	307.0	360.6	17.5
Other musculoskeletal disorders	3846.4	6	5867.0	6	52.5	361.7	371.3	2.7
Iron-deficiency anemia	5615.4	2	4829.9	7	-14.0	456.5	413.4	-9.4
Schizophrenia	2856.0	9	4543.7	8	59.1	262.9	274.1	4.3
Migraine	3058.0	8	4127.0	9	35.0	265.6	265.6	0.0
Anxiety disorders	3208.3	7	3804.6	10	18.6	276.6	267.3	-3.4
Vision loss due to eye disease	**2047.6**	**12**	**3800.4**	**11**	**85.6**	**241.4**	**257.8**	6.8
Osteoarthritis	1477.8	14	3602.7	12	143.8	190.0	218.5	15.0
Chronic obstructive pulmonary disease	2634.1	11	2772.7	13	5.3	316.5	184.4	-41.7
Dysthymia	1435.2	15	2300.2	14	60.3	143.0	143.2	0.1
Drug use disorders	1291.2	16	2156.1	15	67.0	100.6	142.8	41.9
Road injuries	726.9	23	1831.1	16	151.9	74.2	114.8	54.7
Falls	1056.5	19	1606.7	17	52.1	107.4	105.9	-1.4
Food-borne trematodiases	1237.4	17	1527.5	18	23.5	103.9	99.2	-4.5
Bipolar disorder	1075.0	18	1410.9	19	31.3	90.8	91.2	0.4
Alcohol use disorders	929.6	20	1363.9	20	46.7	80.4	85.0	5.7
Ascariasis	1892.0	13	42.7	29	-97.7	164.4	3.0	-98.2

YLDs: years lived with disability

In 1990 and 2015, the burden from vision loss due to eye disease ranked 12th and 11th respectively among all causes of health loss (table 2). Most burdens from various causes increased in 2015 compared with those in 1990, except for Iron-deficiency anemia and Ascariasis. Compared with that in 1990, the All-age YLD total in 2015 increased by 85.6%, the fifth-highest such increase. The Age-standardized YLD rate for the vision loss burden changed much less between 1990 and 2015, increasing by only 6.8%, which was the 6th-highest increase.

DISCUSSION

Previous studies have usually focused on the prevalence of eye diseases alone to evaluate the burden of vision loss. Our study aimed to investigate the vision loss burden in China using both prevalence and YLDs, which enables the comparison of burden from vision loss with those from other diseases and in other countries.

Our findings indicate that the burden of vision loss in China was dominated by Refraction and accommodation disorders, which is consistent with findings in other countries in the world.[14-18] Considering that most Refraction and accommodation disorders can be safely and inexpensively corrected, greater efforts should be made to tackle this problem. 'VISION 2020: the Right to Sight' aims to eliminate avoidable blindness by the year 2020. Refraction and accommodation disorders mostly belong to avoidable blindness and should be considered as a priority. The second-leading cause of vision loss burden was Cataract, which is also the leading cause for blindness in China.[16,19] China's cataract surgery rate (CSR) in2012 was 1072/million/year, which was lower than rates for other countries in the region with lower per capita incomes than China, including Thailand, Vietnam, Laos, Kampuchea, and the Philippines.[19] Tackling Cataract is still a great challenge in China, in part due to inadequate training opportunities for young surgeons.[20,21]

Age-standardized prevalence rates reveal the true burden of eye disease, excluding the effect of population size and age structure. For the past 25 years, age-standardized prevalence rates for Refraction and accommodation disorders, Cataract and Other vision loss remained virtually unchanged, which is particularly concerning, given that these conditions are eminently treatable. Of even greater concern is the fact that age-standardized prevalence rates for Macular degeneration and Glaucoma actually increased over this period. Little progress has been made in controlling these eye diseases. Due to population growth and aging, the all-age prevalences for all major eye diseases in China increased dramatically between 1990 and 2015, and are predicted to increase until 2020. Trachoma was the one exception, whose age-adjusted rate greatly decreased. This is consistent with the fact that WHO has recently certified China free of active trachoma. The ophthalmological data for the GBD were mostly provided by the Vision Loss Expert Group (VLEG). VLEG data showed that all-ages prevalences of involved eye diseases have been increasing (unpublished VLEG data, 2015), which is consistent with the results of the GBD. Meanwhile, VLEG showed that the age-standardized prevalence of blindness (presenting visual acuity <3/60) and moderate and severe vision impairment (MSVI; presenting visual acuity <6/18 but ≥3/60 in the better eye) were decreasing (unpublished VLEG data, 2015). VLEG and GBD described the problem of vision loss problem from slightly different and complementary perspectives. VLEG principally focused on eye disease and paid more attention to severe vision loss. GBD was concerned with public health and paid more attention to vision-related health loss. Combining the results from both VLEG and GBD, it can be inferred that progress has been made in controlling blindness and severe vision impairment, but less so with regard to mild vision loss.

When we studied the vision loss burden by age group, it was encouraging that this fell

between 1990 and 2015 in the 0 to 14-year group. But in the age groups above 15 years, the vision loss burden has increased over this period, particularly among those above the age of 50 years. The observed progress among younger ages may be due to China's one-child policy, promulgated since the 1970s, and the resulting attention paid by families to the well-being of children. But this policy has also led to the rapid aging of China's population, with the proportion aged 65 years and above growing from 5.51% in 1990 to 10.5% in 2015.[22] Most common causes of vision loss are age related, such as cataract, glaucoma and macular degeneration. The ageing population plays a significant role in the increasing burden of vision loss, and national policy should give priority to controlling such eye diseases of aging.

The burden of vision loss in China was somewhat less than that in India and was worse than those in other member countries of the G20. This was to be expected, taking China's large population into account. However, it is worth noting that China was the only country whose age-standardized YLD rate for vision loss in 2015 was higher than that in 1990. This is quite concerning, as it shows that there has been little progress in controlling vision loss over the past 25 years. Further analysis shows that the following two diseases were the main causes for the rise: Macular degeneration and Glaucoma. VLEG data also indicate that the proportion of blindness that can be explained by macular degeneration increased from 5.0% in 1990 to 6.9% in 2010, and for glaucoma increased from 3.9% in 1990 to 5.4% in 2010 in East Asia.[16] These are two diseases that have not yet been widely targeted by Chinese government programs. As noted above, there has been a significant increase in life expectancy in China over the past 25 years,[2-4] which may have led to a higher prevalence of age-related eye disease. Myopia has recently increased rapidly in prevalence in China.[23,24] It seems reasonable that myopic macular degeneration may also have increased. Again, this is a disease which has yet to be targeted by Chinese government programs. Changes in diet and reduced physical exercise may also play a role. The reasons for the higher age-standardized rates need to be clarified by future studies.

The burden of vision loss due to eye disease ranked 12th in 1990 and 11th in 2015 among all causes of health loss in China. The real burden of vision loss may be even worse, as some diseases which damage visual function and lead to blindness, such as diabetic retinopathy, were not included in our study. Furthermore, rarer causes of vision loss among children such as congenital cataract and congenital glaucoma were not investigated in the GBD study. This is understandable, since very few population-based studies have included younger age groups, making it difficult to establish precise estimates.[5] The burden of vision loss may be underestimated due to the scarcity of data for children younger than 15 years.[2,5]

This study has several limitations. Although the GBD Vision Loss Expert Group made every effort to collect all published and unpublished data,[5] the quantity and quality of data available are still limited, which could affect the accuracy of the estimated burden. Also, the estimated vision loss burden in GBD 2015 may be incomplete due to failure to include certain diseases, as noted above. Despite these limitations, GBD remains the most standardized and accurate system available to assess disease burdens across time and place, and across different diseases and injuries.

In summary, this study demonstrates that progress in controlling vision loss from eye disease in China has been sub-optimal over the last 25 years. In the future, China will face more serious population ageing as well as population growth and should thus expect to encounter a growing burden of vision loss. Effective policies and measures to address this rising burden should be a national priority.

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Competing interests None.

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FIGURE LEGENDS:

Figure 1: Prevalence for various eye diseases from 1990 to 2020 in China.

Figure 2: Distribution of prevalence for various eye diseases and YLDs from vision loss due to eye disease in China, by age, 1990 and 2015 (figure left: Prevalence; figure right: YLDs)